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TRENDS IN THE DEVELOPMENT OF MICROPROCESSORS

Abstract: The article describes the importance of microprocessor technologies in modern life. A brief review of the direction of development of microprocessors is given from the beginning of their appearance to the present day. In the article you can find some of the main problems facing the companies that manufacture microprocessors, on the way to their development.

Key words: microprocessor, automatic control systems, transistor.

Modern microprocessor technology is the most important tool for solving a wide variety of tasks in the field of data collection and processing, as well as the development of automatic control systems.

Microprocessor technology in science and technology, industry, agriculture, military industry, everyday life and other areas of human life is becoming more and more in demand. Virtually every electronic system with greater functional complexity is realized with the help of microprocessor devices.

The speed of computer technology depends on which CPU it is installed in. It does not matter what tasks the user puts before the electronic system, the processor plays a major role in them. If it is powerful enough, working with a computer is productive and comfortable.

The history of the development of microprocessor technology has more than fifty years. The process of improving microprocessor technology is the result of a constant desire to increase the processor's performance through the use of increasingly thin technological processes.

For many decades, there has been a sharp rivalry between leading electronic firms for leadership in this field. The result of the struggle for the leading positions in the information technology market is the

development of new types of microprocessors, the expansion of their functionality and rapid growth in productivity and cost reduction [4].

The processor consists of a large number of transistors which are connected to each other. A transistor is a semiconductor element designed to convert, amplify, and redirect electrical signals.

The semiconductor industry has a unique ability to maintain very high rates of technological development over a long period of time. In1965, Gordon Moore, one of the founders of *Intel*, published an article in the Electronics magazine. In the future this article has become legendary, and the assumption made in it has received the name "Moore's law" (Figure 1). There are many interpretations of this law, one of them reads: ″every two years the number of transistors on processors that are profitable to produce doubles" [1].

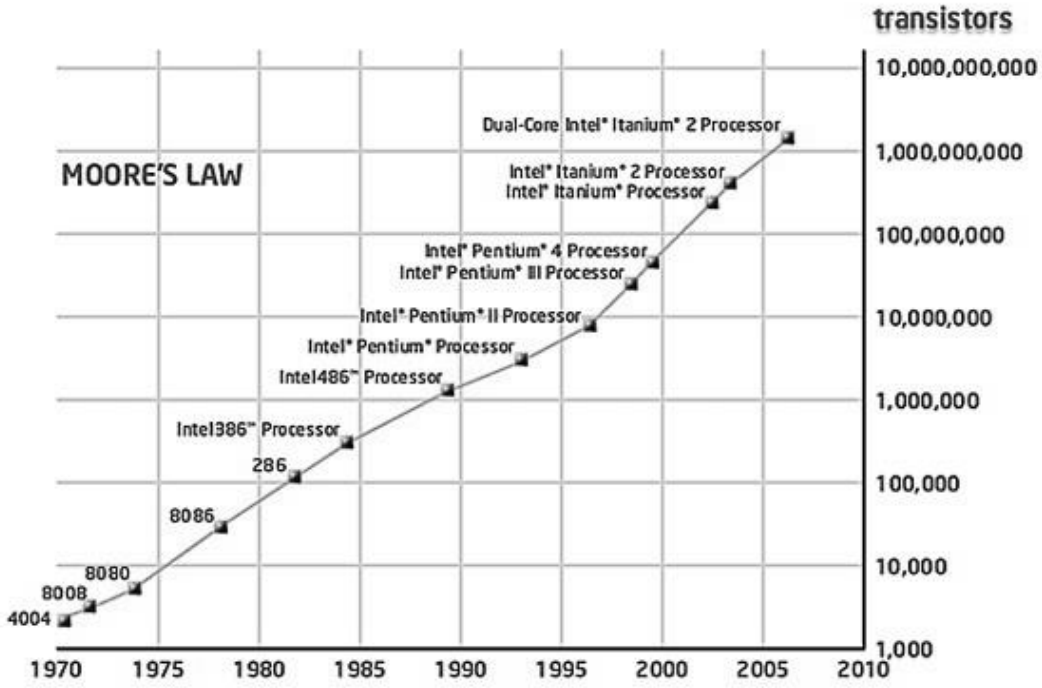

Figure 1 - Moore's law [6]

It should be noted that Moore's law is an observation – it means that, once it may not be fulfilled. But for 50 years, Moore's law has been fulfilled. In fact, the companies that produce microprocessors began to execute this rule. It was an incentive for them.

For a long time, the increase in processor performance was mainly due to a sequential increase in the clock frequency and an increase in the number of transistors on a single chip. On the other hand, further increase in the clock frequency is limited by a number of fundamental physical barriers:

- Firstly, the useful area of the microprocessor, where the transistor can be placed, is finite. Therefore, at a certain stage, the addition of new transistors will involve increasingly large technological problems and high costs, and ultimately an increase in the number of transistors will be impossible.
- Secondly, as the crystal size decreases and the clock frequency increases, the leakage current of the transistors increases. This leads to increased power consumption and increased heat release;
- Thirdly, the advantages of a higher clock frequency are partially eliminated due to delays in accessing memory, since the access time to memory does not match the increasing clock frequencies;
- Fourthly, for some applications, traditional sequential architectures become inefficient with increasing clock frequency due to the so-called "von Neumann bottleneck" - performance limitations resulting from a sequential flow of computations. This increases the resistive-capacitive signal transmission delays, which is an additional bottleneck associated with the increase in the clock frequency [3].

For this reason, now more attention is paid to the parallelization of processes [2]. This is expressed in new directions:

- CMP (Chip Multi Processing);
- SMT (Simultaneous Multithreading);
- EPIC (Explicitly Parallel Instruction Computing) [3].

At present, the transition to new generations of computing resources is becoming particularly relevant. This is due to the needs of solving complex problems of large dimensions. Continuous growth of characteristics requires the development and creation of fundamentally new computational means to support their effective functioning. Thus, knowledge and practical research in this field become necessary for an ever wider range of specialists.

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ТЕНДЕНЦИИ РАЗВИТИЯ МИКРОПРОЦЕССОРОВ

Аннотация: в статье описана значимость микропроцессорных технологий в современной жизни. Приведен краткий обзор направления развития микропроцессоров с начала их появления до настоящего момента и содержатся одни из основных проблем, вставших перед компаниями, которые производят микропроцессоры, на пути их развития.

Ключевые слова: микропроцессор, системы автоматического управления, транзистор.

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